

What is claimed is:

1. A method for producing a semiconductor light emitting device, comprising the step of:

(a) growing a nitride type III-V group compound semiconductor layer that forms a light emitting device structure on a principal plane of a nitride type III-V group compound semiconductor substrate on which a plurality of second regions made of a crystal having a second average dislocation density are regularly arranged in a first region made of a crystal having a first average dislocation density so as to produce a semiconductor light emitting device, the second average dislocation density being greater than the first average dislocation density,

15 wherein the nitride type III-V group compound semiconductor layer does not directly contact the second regions on the principal plane of the nitride type III-V group compound semiconductor substrate.

2. The method for producing the semiconductor light emitting device as set forth in claim 1, further comprising the step of:

(b) removing at least part of the second regions from the principal plane of the nitride type III-V group compound semiconductor substrate,

25 wherein the removing step (b) is followed by the growing step (a).

3. The method for producing the semiconductor

light emitting device as set forth in claim 2, further comprising the step of:

5 (c) removing the second regions from the principal plane of the nitride type III-V group compound semiconductor substrate for a predetermined depth,

wherein the removing step (c) is followed by the growing step (a).

4. The method for producing the semiconductor 10 light emitting device as set forth in claim 3,

wherein the predetermined depth is 1  $\mu\text{m}$  or greater.

5. The method for producing the semiconductor light emitting device as set forth in claim 3,

15 wherein the predetermined depth is 10  $\mu\text{m}$  or greater.

6. The method for producing the semiconductor light emitting device as set forth in claim 1, further comprising the step of:

20 (d) removing all the second regions from the principal plane of the nitride type III-V group compound semiconductor substrate,

wherein the removing step (d) is followed by the growing step (a).

25 7. The method for producing the semiconductor light emitting device as set forth in claim 2,

wherein the removing step (b) is performed by

etching out the second regions.

8. The method for producing the semiconductor light emitting device as set forth in claim 7,

wherein the removing step (b) is performed by  
5 wet-etching the second regions.

9. The method for producing the semiconductor light emitting device as set forth in claim 7,

wherein the removing step (b) is performed by  
dry-etching the second regions.

10. The method for producing the semiconductor light emitting device as set forth in claim 7,

wherein the removing step (b) is performed by  
thermochemically-etching the second regions.

11. The method for producing the semiconductor

15 light emitting device as set forth in claim 1, further  
comprising the step of:

(e) coating the front surface of the second  
regions with a coating layer,

wherein the coating step (e) is followed by  
20 the growing step (a).

12. The method for producing the semiconductor

light emitting device as set forth in claim 11, further  
comprising the step of:

25 (f) removing the second regions from the  
principal plane of the nitride type III-V group  
compound semiconductor substrate for a predetermined  
depth.

13. The method for producing the semiconductor light emitting device as set forth in claim 12, further comprising the step of:

5 (g) filling the removed portions of the second regions with the coating layer.

14. The method for producing the semiconductor light emitting device as set forth in claim 11,

10 wherein the front surface of the coating layer is higher than the principal plane of the nitride type III-V group compound semiconductor substrate.

15. The method for producing the semiconductor light emitting device as set forth in claim 11,

15 wherein the front surface of the coating layer accords with the principal plane of the nitride type III-V group compound semiconductor substrate.

16. The method for producing the semiconductor light emitting device as set forth in claim 1,

15 wherein the plurality of second regions are periodically arranged.

20 The method for producing the semiconductor light emitting device as set forth in claim 1,

20 wherein the plurality of second regions are periodically arranged in a hexagonal lattice shape.

25 The method for producing the semiconductor light emitting device as set forth in claim 1,

25 wherein the plurality of second regions are periodically arranged in a rectangular lattice shape.

19. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the plurality of second regions are periodically arranged in a square lattice shape.

5 20. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the interval of the two adjacent second regions is 20  $\mu\text{m}$  or greater.

10 21. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the interval of the two adjacent second regions is 50  $\mu\text{m}$  or greater.

15 22. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the interval of the two adjacent second regions is 100  $\mu\text{m}$  or greater.

20 23. The method for producing the semiconductor light emitting device as set forth in claim 16,  
wherein the arrangement period of the second regions is 20  $\mu\text{m}$  or greater.

24. The method for producing the semiconductor light emitting device as set forth in claim 16,  
wherein the arrangement period of the second regions is 50  $\mu\text{m}$  or greater.

25. The method for producing the semiconductor light emitting device as set forth in claim 16,  
wherein the arrangement period of the second

regions is 100  $\mu\text{m}$  or greater.

26. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the second regions are formed in an  
5 irregular polygonal prism shape.

27. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein third regions are disposed between  
the first region and the second regions, the third  
10 regions having a third average dislocation density that  
is greater than the first average dislocation density  
and lower than the second average dislocation density.

28. The method for producing the semiconductor light emitting device as set forth in claim 27,  
15 wherein the nitride type III-V group compound semiconductor layer does not directly contact the second regions and the third regions on the principal plane of the nitride type III-V group compound semiconductor substrate.

20 29. The method for producing the semiconductor light emitting device as set forth in claim 28, further comprising the step of:

25 (h) removing at least part of the second regions and the third regions from the principal plane of the nitride type III-V group compound semiconductor substrate,

wherein the removing step (h) is followed by

the growing step (a).

30. The method for producing the semiconductor light emitting device as set forth in claim 1,

wherein the diameter of each of the second regions is 10  $\mu\text{m}$  or greater and 100  $\mu\text{m}$  or smaller.

5 31. The method for producing the semiconductor light emitting device as set forth in claim 1,

wherein the diameter of each of the second regions is 20  $\mu\text{m}$  or greater and 50  $\mu\text{m}$  or smaller.

10 32. The method for producing the semiconductor light emitting device as set forth in claim 27,

wherein the diameter of each of the third regions is greater than the diameter of each of the second regions by 20  $\mu\text{m}$  or greater and 200  $\mu\text{m}$  or smaller.

15 33. The method for producing the semiconductor light emitting device as set forth in claim 27,

wherein the diameter of each of the third regions is greater than the diameter of each of the second regions by 40  $\mu\text{m}$  or greater and 160  $\mu\text{m}$  or smaller.

20 34. The method for producing the semiconductor light emitting device as set forth in claim 27,

wherein the diameter of each of the third regions is greater than the diameter of each of the second regions by 60  $\mu\text{m}$  or greater and 140  $\mu\text{m}$  or smaller.

35. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the average dislocation density of each of the second regions is five times greater than  
5 the average dislocation density of the first region.

36. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the average dislocation density of each of the second regions is  $1 \times 10^8 \text{ cm}^{-2}$  or greater.

10 37. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the average dislocation density of the first region is  $2 \times 10^6 \text{ cm}^{-2}$  or smaller and the average dislocation density of each of the second regions is  $1 \times 10^8 \text{ cm}^{-2}$  or greater.

15 38. The method for producing the semiconductor light emitting device as set forth in claim 27,  
wherein the average dislocation density of the first region is  $2 \times 10^6 \text{ cm}^{-2}$  or smaller, the average dislocation density of each of the second regions is  $1 \times 10^8 \text{ cm}^{-2}$  or greater, and the average dislocation density of each of the third regions is  $1 \times 10^8 \text{ cm}^{-2}$  or smaller and  $2 \times 10^6 \text{ cm}^{-2}$  or greater.

20 39. The method for producing the semiconductor light emitting device as set forth in claim 1,  
wherein the nitride type III-V group compound semiconductor substrate is made of  $\text{Al}_x\text{B}_y\text{Ga}_{1-x-y-z}\text{In}_z\text{As}_u\text{N}_{1-u}$ .

$vP_v$  (where  $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ,  $0 \leq z \leq 1$ ,  $0 \leq u \leq 1$ ,  $0 \leq v \leq 1$ ,  $0 \leq x + y + z < 1$ ,  $0 \leq u + v < 1$ ).

40. The method for producing the semiconductor light emitting device as set forth in claim 1,

5 wherein the nitride type III-V group compound semiconductor substrate is made of  $Al_xByGa_{1-x-y-z}In_zN$  (where  $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ,  $0 \leq z \leq 1$ ,  $0 \leq x + y + z < 1$ ).

10 41. The method for producing the semiconductor light emitting device as set forth in claim 1,

wherein the nitride type III-V group compound semiconductor substrate is made of  $Al_xGa_{1-x-z}In_zN$  (where  $0 \leq x \leq 1$ ,  $0 \leq z \leq 1$ ).

15 42. The method for producing the semiconductor light emitting device as set forth in claim 1,

wherein the nitride type III-V group compound semiconductor substrate is made of GaN.

43. The method for producing the semiconductor light emitting device as set forth in claim 1,

20 wherein the semiconductor light emitting device is a semiconductor laser.

44. The method for producing the semiconductor light emitting device as set forth in claim 1,

25 wherein the semiconductor light emitting device is a light emitting diode.

45. A method for producing a semiconductor device, comprising the step of:

growing a nitride type III-V group compound semiconductor layer that forms a device structure on a principal plane of a nitride type III-V group compound semiconductor substrate on which a plurality of second regions made of a crystal having a second average dislocation density are regularly arranged in a first region made of a crystal having a first average dislocation density so as to produce a semiconductor device, the second average dislocation density being greater than the first average dislocation density,

wherein the nitride type III-V group compound semiconductor layer does not directly contact the second regions on the principal plane of the nitride type III-V group compound semiconductor substrate.

46. The method for producing the semiconductor device as set forth in claim 45,

wherein the semiconductor device is a light emitting device.

47. The method for producing the semiconductor device as set forth in claim 45,

wherein the semiconductor device is a photo detector.

48. The method for producing the semiconductor device as set forth in claim 45,

wherein the semiconductor device is an electron traveling device.

49. A method for producing a semiconductor light

emitting device, comprising the step of:

growing a nitride type III-V group compound semiconductor layer that forms a light emitting device structure on a principal plane of a nitride type III-V group compound semiconductor substrate on which a plurality of second regions made of a crystal having a second average dislocation density are regularly arranged in a first region made of a crystal having a first average dislocation density so as to produce a semiconductor light emitting device, the second average dislocation density being greater than the first average dislocation density, the second regions being arranged at a first interval in a first direction and at a second interval in a second direction perpendicular to the first direction, the second interval being smaller than the first interval,

wherein the nitride type III-V group compound semiconductor layer does not directly contact the second regions on the principal plane of the nitride type III-V group compound semiconductor substrate.

50. A method for producing a semiconductor light emitting device, comprising the step of:

growing a nitride type III-V group compound semiconductor layer that forms a light emitting device structure on a principal plane of a nitride type III-V group compound semiconductor substrate on which a plurality of second regions that linearly extend and

that are made of a crystal having a second average dislocation density are regularly arranged in parallel in a first region made of a crystal having a first average dislocation density so as to produce a 5 semiconductor light emitting device, the second average dislocation density being greater than the first average dislocation density.

wherein the nitride type III-V group compound semiconductor layer does not directly contact the 10 second regions on the principal plane of the nitride type III-V group compound semiconductor substrate.

51. A method for producing a semiconductor device, comprising the step of:

growing a nitride type III-V group compound 15 semiconductor layer that forms a device structure on a principal plane of a nitride type III-V group compound semiconductor substrate on which a plurality of second regions made of a crystal having a second average dislocation density are regularly arranged in a first region made of a crystal having a first average 20 dislocation density so as to produce a semiconductor device, the second average dislocation density being greater than the first average dislocation density, the second regions being arranged at a first interval in a first direction and at a second interval in a second direction perpendicular to the first direction, the 25 second interval being smaller than the first interval.

wherein the nitride type III-V group compound semiconductor layer does not directly contact the second regions on the principal plane of the nitride type III-V group compound semiconductor substrate.

5 52. A method for producing a semiconductor device, comprising the step of:

10 growing a nitride type III-V group compound semiconductor layer that forms a device structure on a principal plane of a nitride type III-V group compound semiconductor substrate on which a plurality of second regions that linearly extend and that are made of a crystal having a second average dislocation density are regularly arranged in parallel in a first region made of a crystal having a first average dislocation density  
15 so as to produce a semiconductor device, the second average dislocation density being greater than the first average dislocation density.

20 wherein the nitride type III-V group compound semiconductor layer does not directly contact the second regions on the principal plane of the nitride type III-V group compound semiconductor substrate.

25 53. A method for growing a nitride type III-V group compound semiconductor layer on a principal plane of a nitride type III-V group compound semiconductor substrate on which a second region made of a crystal having a second average dislocation density is contained in a first region made of a crystal having a

first average dislocation density, the second average dislocation density being greater than the first average dislocation density.

wherein the nitride type III-V group compound semiconductor layer does not directly contact the second region on the principal plane of the nitride type III-V group compound semiconductor substrate.

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